Project Summary

People who are deaf or hearing impaired have limited communication channels when there is no interpreter available. They must rely on either typing or using hand gestures that a hearing individual can understand. This at times may be frustrating and challenging to the hearing impaired individual because they are not using their natural language to communicate. Communicating with such language barrier also takes extra time than if the conversation was seamless. The proposed project tries to bridge the communication barrier by implementing an ASL to voice video chatting interface system. This project plans to use machine learning, computer vision, and video modification software to allow the targeted individuals the opportunity to have a conversation with someone who does not understand ASL, in real time. The equipment required for this project is the Microsoft Kinect sensor, video modification libraries, and ASL video libraries.

Intellectual Merit:

This Small Business Innovation Research Phase I project will lie within the the recognition of gestures and machine learning. The recognition of gestures, specifically finger tracking has become increasingly popular and more researched. Many companies are integrating finger recognition into their products, such as video games and phones. As technology advances, devices will move away from the touch screen and begin to rely more on finger and voice recognition. This project will dive into tracking finger gesture libraries that already exist and will improve them by extend finger gesture technologies to recognize ASL. The translation of ASL hand gestures to text is a current problem without a published and accurate solution. Additionally, this project will involve machine learning, which is a current problem that will always have room for advancement as technology improves. Machine learning will be used as different users will have different sign styles and the software will need to learn when to accept a word and when to reject. The largest anticipated challenge will be distinguishing ASL from common hand gestures. Examples of common hand gestures is scratching a nose or moving a piece of hair from the cheek. Another anticipated problem the project may face will be the processing time and having the translations occur in real time. The more software implemented, the slower the translations. Given that voice detection software is already published, this project will integrate that technology in a way that the transitions are undetected.

Broader Impact:

The broader impact of this project is to improve social norms when it comes to communicating with individuals of the deaf or hearing impaired community. Currently, the targeted audience work harder to be understood by their hearing counterparts. What is proposed has the potential to be used on many platforms besides the Microsoft Kinect. The primary demographic of this project can use this software on their mobile devices and personal computers. The outcome of this project is the first step towards bridging the gap between people with a language barrier. This program can also be expanded to work with other sign language dialects across the world and be translated into many foreign languages.

Elevator Pitch:

Everyone has participated in a conversation with someone who speaks a different language than them. Many also know the feeling of being misunderstood and the frustration of not being able to clarify their thoughts. It is likely that deaf and hearing impaired individuals feel this way whenever they are communicating with a hearing person because most people do not understand American Sign Language. In today's society and business practices, the most convenient way to virtually interact with others is through videoconferencing. Without the assistance of an interpreter, telecommunication between the deaf/hearing impaired and someone who does not know sign language are limited to text messages and other text chatting systems. What if there was a video chatting interface that could break that language barrier? What if there was a way to allow the people who sign to have a conversation with someone with no signing experience in an effortless manner?

This is the idea behind EC-Chat: The ExClusive Deaf-Inclusive Video Chat Interface. With this proposed interface, the deaf/hearing impaired community will have one more outlet for communicating with individuals who do not understand sign language. This technology will have the ability to translate ASL into text and speech to text in real time. The current technology available for closed captioning is only useful for editing videos after they have been created. No other video chatting interface has the capability to translate a conversation during a live stream. Incorporating these two aspects into EC-Chat will provide a tool that will be useful for business interactions, large conferencing events, and for personal everyday use.

This project will incorporate machine learning and data mining in order to accurately translate the ASL signals. ASL is a complex language and has many classifications: facial expression, palm placement, location, stationary and non-stationary. This project will focus on stationary and basic non-stationary signs due to time constraints.

EC-Chat has three components: the ASL to text translation, the speech to text translation, and the video chatting interface. Transcribing ASL into text will involve using machine learning techniques to classify and interpret the data to convert it to American English. Translating speech to English has already been implemented on various platforms. This software plans to integrate the three components into a usable application that can be accessed online. The outcome for this project is to connect individuals who speak different languages without the complexities of having to translate one's thoughts. EC-Chat aims to handle all of the translations. ASL and American English are the main languages for this project, but this software can be expanded to support other languages in the future.

Commercial Impact

This product will become a feature that can be integrated into any software on the market. Video chatting interfaces will be able to use this software if the equipment requirements are met and upgraded. This would lead to the innovation of new video chatting software that will help bridge the language barrier gaps between not only American Sign Language and English, but other sign languages and spoken languages. As communication channels within businesses escalate to a new global level, the difficulties of finding bilingual translators has become a large problem in many companies. The time and money that is spent on bridging communication gaps is costly and the future of EC-Chat would solve many of those problems and cut costs dramatically.

Economically, this software could get pricy for installation, given the requirement for a finger-tracking sensor built in. However, the development of future versions of this project could lead to new software and hardware that minimizes costs. Companies that select to purchase and install this software will not need to provide each employee with the equipment, just enough to meet the company's needs. Overall, the one time cost of the hardware and software could end up saving companies a lot of money due to the increase in productivity it could provide.

Customers could be anyone from around the world. While it targets companies at the industry level, individuals may greatly benefit from using this product as it will simplify and expedite communication between the hearing impaired and hearing people. EC-Chat’s capabilities can unify communities within social groups and workplaces. Even though its original functionality is to provide a medium of teleconferencing between American Sign Language and English, it will be extended to other languages and can be used as a standalone tool to translate sign language to another spoken language between two users, even if they are both on the same side. It could be applied heavily in the customer service field. Customer service agents or retail associates globally could utilize this software to help serve the hearing impaired community. EC-Chat’s basic business model is that EC-Chat will help global communication between the hearing impaired and hearing.

Currently, there is no competition on the market for our product. There have been prototypes made by different groups utilizing the Kinect that has a similar outcome to our product, however there is no product on the market, or rumors of one emerging. Similar to when any new product arrives on the market, when EC-Chat enters the market, pending its success rate, other companies will likely develop their own version and deploy. Due to EC-Chat’s dependency on the Kinect, there could be legal issues and patenting rights that may arise, or Microsoft could work to quickly deploy their own version.

The largest risk falls within the reliance on existing software. EC-Chat could be an application similar to many companies that publicly states its integration of open source libraries such as the open Kinect, speech to text and finger-tracking. Pending the success of the EC-Chat software, EC-Chat could expand to develop its own hardware, which it would sell alongside of its software. Additional risks with the innovation of EC-Chat could be the evolvement and expansion of the software to brand new products that lie out of EC-Chat’s original goals.

The commercialization approach to this product will be difficult. It will require checking to make sure EC-Chat's documents legally references all of the open source libraries it utilizes correctly, especially ones geared towards the Microsoft Kinect. The first step after having a polished product would be to brand it and get its name out. EC-Chat is targeted for everyone, and therefore it could be publicized in many places, especially in the deaf community. After it is publicized, a prototype could be rolled-out in order to gage the industry's reaction. The product and company could quickly expand as more people begin to realize the benefits from EC-Chat.

Aside from the aforementioned economic benefits, the benefits for communities and individuals who are, or who interact with hearing impaired people, will be priceless with the effect of this software. Monetary benefits to communities and individuals could be the increased participation or productivity which could raise or save money for them. EC-Chat itself will not be expensive, it will be the hardware that ends up being the most expensive part. EC-Chat likely will have minimal revenue at the beginning, but once the product is being has gained traction, more employees could be hired, and the company could expand capabilities of this product and grow, increasing in size and stock value. Assuming that the EC-Chat software is sold separately from the Microsoft Kinect, each EC-Chat installation would be fifteen dollars a month for premium features. After EC-Chat gains success, it could expand and provide more services, offering more opportunities for revenue. The only estimate that can be made now is that EC-Chat wants to break even financially. To break even, EC-Chat will have to bring in enough revenue to cover the costs for maintenance and equipment updates that may be needed for future versions.

Social and Global Impact

The goal of this project is to allow two individuals who speak different languages the opportunity to converse with one another. More specifically, this project is intended to bridge together the deaf and hearing-impaired community with the hearing population. People avoid interactions with others who speak different languages because it is hard to communicate one's thoughts, it is time consuming, and both parties do not want to make the other person feel frustrated or judged. In an earlier time period, people who were hard of hearing were ridiculed, degraded, and insulted because they were viewed as being different. As society is becoming more inclusive, the population has become more open-minded and conscientious about dealing with language barriers; however, there is still work that can be done. EC-Chat can be advance the solutions to this problem.

This commercial opportunity can be used in a wide range of areas, from businesses, conferences, and for personal use. In an effort to improve work-life balance, most companies allow for their employers to work from home. Telecommunication is key in this particular business model. Having a tool that translates sign language into text can allow for hearing impaired people to work from home. Companies could save a lot of time and money by using this product. Instead of hiring multiple interpreters to take turns translating, EC-Chat can do the translations for long periods of time. This will be especially beneficial in large conferences or workshops. EC-Chat can give the person who is hard of hearing the courage to speak out and become more involved in the conversation. This will hold true in their personal lives as well.

Interacting with people who are not hard of hearing, in a less frustrating manner, allows for relationships to grow between the deaf and hearing communities.

While EC-Chat aims to create another means of communication for people who sign, there are some environmental issues to consider. First, the current implementation requires the use of a Microsoft Kinect. For businesses, this would be feasible for a company to provide reasonable accommodations for their employers. It would not be worthwhile for people to purchase this equipment for personal use. For workshops, EC-Chat would best be used on mobile devices. Second, the design of this product has to take into account that people who sign have distinct mannerisms just as hearing individuals can have accents and slang that is specific to a region. EC-Chat will be designed for American Sign Language. It will not work for signs that small groups create amongst each other.

Another thing to consider are the external factors that affect the accuracy of the translations. If EC-Chat were to be compatible on mobile devices, the camera quality, the size of the mobile device, and the location can influence the results. There are certain camera qualities to consider such as the resolution, the filters on the camera, and the focus/positioning of the camera. Currently, EC-Chat is not responsive, which means that the graphical user interface will not adapt to the varying sizes of mobile devices. Lastly, the location of where the user is can affect the video stream. The room could be poorly lit, or the natural light from the windows could interfere with the camera.

As with any product on the market, EC-Chat is vulnerable to being used in unethical situations. Since some of the software incorporated into this program will be extensions of open source implementations, the application can skew the way this program interprets signs. For example, if someone signed a gesture that the software deems inappropriate, the software may not interpret or relay that information. Mishandling the data, could be a potential issue on the other end of EC-Chat as well, where the speech recognition software may not display profane language. This is an issue that could arise in any situation. Interpreters ultimately decide what is or is not relevant to translate. The priority of EC-Chat is to make sure that the software is accurately interpreting the signs.

EC-Chat will also be susceptible to hacks. For instance, a hacker could program the Kinect to turn on, at any moment, to record and store photos. They could also reprogram this product to misinterpret the data. At this stage in development, there is no security measure to prevent these attacks from happening. Providing security measures will have to require collaboration with security companies, so that they can provide the necessary tools for this application.

The global impact that can be achieved through EC-Chat is immeasurable. There are over 100 different dialects of sign languages, such as British Sign Language and Mexican Sign Language. Developing countries may have a greater divide between the hearing and the hearing-impaired groups. Some may not have access to food or shelter because of this. EC-Chat could be extended to support these different dialects. This would allow for more

resources to be brought to hard of hearing individuals in developing countries. Furthermore, EC-Chat could potentially support video conversations between two individuals who speak different sign languages.